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Title: Making knowledge and meaning in communities of practice: what role may science play? The case of sustainable soil management in England.

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Running Title: Making knowledge and meaning in social learning.

Abstract

Social learning is gaining popularity as a tool for understanding and designing interactions between experts and farming communities to enhance the uptake of sustainable and innovative farming practices. To date the literature has mainly focused on the technical role scientists and researchers play in social learning, as sources of or co-producers of knowledge. Social learning, however, implies a dynamic between the creation of knowledge (what can be done) and the creation of meaning (what is considered worth doing). This paper addresses this research gap by exploring the roles that 'expert' actors and their narratives perform in meaning-creation. I argue that a sustainable soil management community of practice is emerging in England, and discuss the dynamics of farmer participation in this community. I further argue that members of this community use scientific 'experts' and narratives to inspire, justify, and legitimise sustainable soil management as a valid way of being a 'good farmer'. This paper thus stresses the role that scientific or 'expert' actors and narratives play in communities of practice as contributors to meaning-creation inherent to social learning. How soil degradation will be addressed is as much a technical question, a question of what can be done, as a question of meaning, a question of what land managers consider worthwhile doing. The scientific community thus needs to work *with* the farming community not only to co-produce technical solutions, but also to co-produce shared visions of agrarian futures which put soils at their heart.

Keywords: knowledge exchange, social learning, meaning-creation, knowledge co-production, adoption

Introduction

Globally, soil degradation is one of the biggest challenges to food security and environmental sustainability. In the United Kingdom, concerns about the loss of functionality in agricultural soils are rising; changing management practices by landowners towards soil conservation and restoration is becoming a policy priority (Environmental Audit Committee, 2016). This paper considers both the character of the rising interest in sustainable soil management (SSM) (Ingram & Mills, 2018) amongst conventional English farmers, and the role that scientific and research communities may play in enhancing uptake of these practices by farmers.

The influence of 'experts' and of scientific knowledge on the adoption of sustainable or innovative farming practices is a long-standing concern for scholars of agricultural extension, rural sociology, and geography. However, research has primarily focused on the technical role these 'experts' and their knowledge perform. While the desirable forms of 'expert'-farmer interactions have moved beyond unidirectional knowledge exchange towards more participatory, social learning and co-production frameworks (Ison & Russell, 2007), the 'experts' continue to be cast in these interactions as primarily involved in the communication of or co-creation of knowledge (Leeuwis, 2004; Oreszczyn *et al.*, 2010; Reed *et al.*, 2013). Consequently, and in relation to soil restoring and conserving practices specifically, much stress has been placed on understanding what kind of knowledge land managers require for land conservation (Ingram, 2008), and designing the best way of building and exchanging this knowledge (Curry *et al.*, 2012). Advancing mutual exchange of knowledge and information as well as enhancing inquiry by farmers themselves have similarly been seen as important, with researchers from both social and soil science

disciplines calling for closer links between the research and farming communities (Doran, 2002; Bouma, 2015; Lobry de Bruyn *et al.*, 2017) together with more participatory approaches (Brown *et al.*, 2018). In England, building collaborations has been particularly challenging due to the disappearance of state-funded forms of knowledge exchange, and the resulting research-practice gap (Godwin *et al.*, 2008; Kibblewhite *et al.*, 2010; Curry et al., 2012).

This paper will broaden the focus of past studies of farmer-'expert' social learning beyond a focus on their technical content, and highlight the role 'expert' actors have in influencing the creation and maintenance of social learning groups. I focus on the emergence of one social learning group, a community of practice (CoP) amongst farmers practicing SSM in England. Scientists, scientific knowledge and scientific tools, I argue, are being strategically used by this community to refine, articulate, and strengthen both the content of their learning ('what can be done'), and their shared sense of purpose ('what is worth doing'). This study shows that for the farmers involved in this CoP scientists and researchers are not only sources of knowledge and information but also resources for inspiration, justification, and legitimisation in relation to the shared sense of purpose of the CoP. Paying more attention to these kinds of influence of 'expert' actors has important consequences for the future support for and structuring of social learning interactions.

In the following sections, I present the communities of practice theoretical framework, drawing attention to salient literature in science and technology studies (STS) on the strategic uses of expertise. I then use data from qualitative research conducted with English farmers to argue, firstly, that a CoP is emerging around SSM in England, and secondly, that

scientific actors and scientific forms of knowledge are being mobilised by this CoP to enhance both its technical learning and its sense of purpose.

Materials and methods

Communities of practice, and the strategic uses of expertise

The community of practice (CoP) approach belongs to a body of theoretical literature which approaches learning as a social activity, and stresses that adoption of new practices by actors is simultaneously a technical and a socio-cultural process (Vanclay, 2004; Eshuis & Stuiver, 2005; Schneider *et al.*, 2010). Communities of practice are groups of individuals who share certain practices, and who jointly negotiate the meaning of and ascribe value to these practices (Wenger, 1998). Discussing research strategies of a university department, arguing about the ethics of breeding pedigree dogs, or debating the 'proper' way to play jazz can all be seen as negotiations of meaning in CoPs of university managers, dog owners, and jazz musicians, or the building of a 'joint enterprise' in these communities (Wenger, 1998). CoPs are not therefore limited to work-related activities; we all participate in various CoPs throughout our lives. The joint enterprise of a CoP is shaped in relation to processes internal to the CoP, such as individual experimentation (Cross & Ampt, 2017), and can be influenced by interactions with external actors (Oreszczyn et al., 2010). From the perspective of a CoP, acquiring new knowledge and ascribing value to this knowledge, or learning and meaning-creation, cannot be disaggregated; CoPs are not only spaces of knowledge production, but also act as 'spaces where norms shaping individual behaviour are collectively constructed and new narratives can be produced, [and this perception] empowers participating farmers

as agents of change' (Dolinska & d'Aquino, 2016). In CoPs, knowledge is not only the possession of relevant information and skills but also a competent participation in the joint enterprise (Wenger, 1998 p. 4). Learning in a CoP is not just 'an acquisition of memories, habits, and skills, but the formation of an identity' (Wenger, 1998, p. 96), of becoming someone that other CoP members recognise as a competent practitioner; for example, a 'good farmer' (Burton, 2004).

The CoP approach and similar frameworks are increasingly being used to understand and design interactions between farmers and 'experts'. However, the predominant focus has been on the learning and innovation-enabling role that CoPs perform (Oreszczyn et al., 2010; Morgan, 2011; Madsen & Noe, 2012). The meaning-creation aspects of agrarian CoPs have been explored less; notable exceptions include the use of 'life-worlds' to draw attention to the relationship between practices and meanings in social learning (Schneider et al., 2010), and the assessment of the importance of shared narratives in the uptake of innovative farming practices (Dolinska and d'Aquino, 2016).

In this paper I consider the meaning-creation dimension of agrarian CoPs as inseparable from their 'technical' function. Concentrating on this aspect opens up a novel perspective on the importance of farmer-'expert' networks beyond the current preoccupation with farmer uptake of or engagement with scientific knowledge and information (Tsouvalis *et al.*, 2000; Sligo & Massey, 2007; Ingram *et al.*, 2016; Mills *et al.*, 2017), or on conflicts between 'expert' and farmer knowledge (Wynne, 1996; Carolan, 2006; Morris, 2006). Although the importance of collectively negotiated meanings of farming practices, such as the 'good farmer' ideal (Burton, 2004) and styles of farming (Van der Ploeg, 1994), has been

recognised, little attention has been given to how 'expert' knowledge and actors may contribute to shaping these collective meanings.

The relationship between shared societal meanings and expert knowledge has been an object of study in science and technology studies (STS). This literature highlights the many ways in which social groups enlist, contest, re-appropriate, re-contextualise, and re-design 'expert' knowledge to support and strengthen their agendas (McCormick, 2007). In this study, I identify inspiration, justification, and legitimisation as important aspects of the influence that 'expert' communities are having on the formation of a SSM CoP in England beyond knowledge generation and transmissions.

The importance of passion and emotion in the work of producing science is well acknowledged within the field of STS (Lorimer, 2008; Pickersgill, 2012), and is increasingly being embraced in science education and communication (Girod *et al.*, 2003). This study draws attention to how 'expert' actors and their products can emotionally affect farmers, inspiring them to seek out alternative perspectives and practices on soils and helping to support early engagement with SSM practices. With regards to justification and legitimation, STS scholars have stressed the role that scientific actors, institutions, narratives and tools play as sources of 'epistemic authority' (Herbst, 2003) due to the perception of scientific knowledge as expressing universal truths (Shapin, 1998). This is particularly the case in questions related to the environment, where scientific understandings have established a powerful (albeit contested) dominance over other forms of knowledge (Bocking, 2004). This strategic use of science is particularly important for groups which struggle for legitimacy and recognition (Pellizzoni, 2011), as is the case, I argue, for the SSM CoP in England.

I distinguish between two such strategic uses of scientific narratives and knowledge by the members of the SSM CoP. Firstly, the farmers use scientific narratives about the general benefits of SSM practices to justify their decision to take these up to others. This allows them to avoid the issue of providing quantifiable 'proof' of the advantages of SSM for their specific lands and businesses. In these instances, scientists and researchers and their products are referred to as sources of epistemic authority ("if they say it, it must be true"). At the same time, the farmers recognise the specificity of the SSM practices, and the difficulties of 'proving' the benefits of SSM in situ. As a result, they are calling upon science to study the effects of SSM in specific settings to legitimise their commitment to it through the scientific method, which is seen as objective and universal and therefore authoritative. In these uses, science is called upon to serve and strengthen the pre-existing conviction and direction of the SSM CoP ("it is true, but they can tell us why/how"). Through inspiration, justification, and legitimisation, scientific actors and scientific knowledge are contributing to the formation and maintenance of the emerging CoP, and in the development of a shared sense of purpose.

Methodology

In this article I discuss findings from a thematic analysis of interviews and farm visits with 22 conventional (i.e. not organic) farmers in England conducted in 2016-2018 (10 arable, 9 mixed, 3 livestock farming systems). I interviewed these farmers, who self-identified as practicing sustainable soil management methods and covered all points of the spectrum of SSM, from the more conventional farming systems using rotational ploughing, to the most modified farming systems employing the full range of conservation agriculture practices

(Lahmar, 2010). The farmers varied in their length of experience with SSM methods (minimum 2 years, maximum 20), and represented a diversity of farm sizes, with the two smallest holdings at 69 hectares, and the largest at 3500 hectares. The sample ensured geographical and soil type variation, with seven farms situated in the North, five in the Midlands, four in the East, and five in the South of England. Initial phone interviews were followed up with farm visits and walking interviews, generating 2-4h of audio material per participant. The interviews were transcribed and coded in NVivo combining thematic analysis and grounded theory approaches (Silverman, 2013). The study was conducted in accordance with the University of Sheffield's research ethics approval procedures. The material discussed herein draws on codes related to the experience of the farmers with and their perceptions of SSM practices, to their experience with and perceptions of soil 'experts' (scientists, researchers, and soil-focused agronomic advisors), and their experience with and perceptions of soil-related scientific research. Participant observation at 8 farmer-oriented events which featured soils as a particular focus (3 farmer conferences, 1 soil food web training, 2 monitor farm meetings, 2 farmer group meetings) provided further information about the background of current interest in SSM in English conventional farming, its distinctiveness from the organic movement, the structure of the emerging CoP, and its geographical dispersal.

Results

The results focus on farmers becoming sustainable soil managers and the role of science in this transition. In the following sections, I illustrate three stages of participation in the SSM farming CoP based on the interview material: seeking, experimenting, and contributing. I draw attention to the importance of scientific knowledge, actors, and institutions at all

stages of participation through inspiration, justification, and legitimisation. However, I am not suggesting that inspirational, justificatory, and legitimising roles of scientific knowledge and actors correlate exclusively to particular stages of a farmer's involvement in the SSM CoP.

Seeking: being exposed to a community of practice, and science as inspiration

The early stages of considering changing soil management are when farmers discover the existence of the SSM CoP, and realise that a different way of farming, which is neither organic nor entirely 'conventional' is being practiced. With respect to the initial motivations for becoming interested in soils, farmers identified concerns about inefficiency, such as the amount of time and fuel spent on establishing seed beds, or a desire to increase productivity, such as enhancing sub-optimal yields or maximising micro-nutrients in crops (c.f. Ingram, 2010). None of the farmers interviewed indicated environmental or soil conservation concerns as their initial motivation for engaging in SSM practices. Once they became aware that changing soil management was a potential way to address these productivity or efficiency related issues, the farmers sought out further information without discriminating between farmer-generated and scientific/research sources.

At this stage, the farmers are peripheral members of the SSM CoP (Lave & Wenger, 1991). In seeking new information, they step out of their comfort zone and become involved in boundary practices at the intersection of their current competence as conventional farmers, and the areas of competence of groups with greater soil knowledge such as soil scientists, researchers, and SSM farmers. The importance of boundary interaction to learning in CoPs has been widely commented on (e.g. Oreszczyn et al., 2010). However, the farmers described being exposed to farmers who practiced soil conservation and also to the

messages of soil scientists/researchers at this 'seeking' stage not only as the acquisition of new information, but as a very profound shift in their understanding of the role that soils played in their farming. This shift is particularly linked with a change of perceptions about soils from seeing soils as an inert substrate to a living system (Vankeerberghen & Stassart, 2016). Farmers described this as a change in perspective or mentality, an inspiration, or even 'a farming life-changer' (S2).[1] As one farmer (N8) recalled; 'I'd always thought the organic matter was better off being mixed into the full soil profile. (…) at that meeting I learned that the organic matter and most of the life of the soil was in the top sort of two inches of the soil. (…) So that was a sort of, I wouldn't say an epiphany, but it was a change of mind-set from that meeting onwards'.

Some farmers identified particular scientists as inspirational, such as the American microbiologist Elaine Ingham, who 'opened my eyes to a whole new world' (E15); others indicated being inspired by specific farmers. Regardless of the source, farmers expressed the sense of their existing thinking being challenged, and realising that 'there is more and different research going on other than just the run of the mill, you go to a Bayer crop protection evening and it's you must spray this and this and this, well actually you don't have to do that, there are other things that you can do' (M3).

[1] Farmers are referred to in the article by a combination of geographical indication (N for North, M for Midlands, E for East S for South of England) and number in the sample.

Experimenting: joining the community of practice, and science as justification

After a variable amount of time spent in the 'seeking' stage, farmers complemented their information gathering activities with on-farm experimentation. In contrast to conventional farming, SSM was seen to 'have no blueprint', meaning local adaptation of general rules was necessary (as typical of sustainable farming practices, see Morgan & Murdoch, 2000). For some farmers, starting the experimentation meant 'biting the bullet' (N8) and, for example, investing full-scale into direct drilling machinery; for others the process was more gradual, with an adoption of only some of the elements of the system, or using contractors to try out new practices on a particular site.

Commencing experimentation immediately set these farmers apart from their proximate farming community. The farmers' departure from farming as practiced by their neighbours was indicated by nuanced reference to the changed aesthetics of their fields, which the farmers feared looked 'scruffy' to a conventionally trained farmer's eye. Furthermore, the timing of their farming operations no longer necessarily correlated with those of their neighbours: the farmers were not visibly working when others worked; their crops had different germination and growth rhythms. As a result, the farmers interviewed were very aware that their fields communicated a break-down of what others may see as 'normal' practice (Schneider et al., 2010), and felt themselves branded as 'mad' by their neighbours (Ingram 2010). This sense of rupture from the immediate farming community created strong feelings of isolation and even loneliness amongst the farmers interviewed, especially those in the early stages. One farmer commented, (M18) 'sometimes it does feel very lonely when you see your bad fields and the neighbours good fields'. Another farmer who had recently started experimenting with minimum tillage, described how being

'different' was stressful as it was putting his reputation on the line, and even endangering his contracting business:

> (M2): It would be nice to see other people practicing it in the area, and seeing how they get on because, you know I'm sort of sticking my neck out doing what I'm doing (…) I don't particularly want to be pushing the boundaries too far really to the extent that, yes I end up getting either egg on my face or losing money (…) or credibility.

At the experimentation stage, the farmers can be seen as actively joining the SSM CoP, as the adoption of SSM practices typically went hand in hand with increased participation in both physical and virtual groups of 'like-minded' farmers. Online activity was pronounced, with all farmers interviewed being active on an online forum, Twitter, or WhatsApp groups, highlighting the dispersed character of the conservation agriculture CoP (Wenger *et al.*, 2002). These forms of communication allowed farmers to connect internationally, particularly with farmers in Australia, New Zealand, and the US who shared their language, but who had a longer experience of soil conservation methods. The farmers stressed that this increased interaction was crucial to them taking their first step into SSM, and to maintaining their practice in a largely unsupportive environment. As one farmer explained in relation to his and a colleague's participation in their local group:

> (S2): I wouldn't be able to do this on my own. I think (Name) has struggled being out there on his own, and farming effectively on his own, because he makes huge leaps in his management, and then falls back because everyone around him is conventional, and that farming community effectively isolates him. And he thinks oh, I might just do it the old-fashioned way.

This particular farmer was suggesting that interacting with other members of the CoP was central to maintaining a sense that the SSM practices are meaningful and not a waste of time and effort. A sense of community was seen as very important in remaining committed to what some may see as a difficult and unnecessary process. Similarly, a more experienced SSM farmer commented:

> (E15): just being able to talk about what we're doing with likeminded farmers, I'd never have gotten as far, or even dared to do what I've done without knowing that other people are out there with the same ideas and doing the same sort of thing.

A CoP is united not only by a shared set of activities, but also by joint enterprise: a system of meaning which makes the activities significant and valuable to the members. Becoming a member of a CoP is a process of both taking up the practices, and of accepting the system of meaning, which ascribes value to these practices. In relation to conservation agriculture, as CoP members the farmers expressed belief that SSM was 'the right thing to do' even when they were unable to indicate specific positive effects for their farm business. As one farmer explained when asked why he was continuing with SSM methods:

> (N10): What makes me do it, comes back to intuition, I just think for all sorts of reasons and all the things I've picked up in the last few years doing it, I think this is right, the right thing to do (…) in my mind it's the right thing to do.

Importantly, the farmers used scientific narratives to justify soil conservation as 'the right thing to do' rather than using scientific methods to systematically validate that it indeed was the right thing to do in relation to specific indicators. While all the farmers interviewed used scientific hypotheses to *justify* the reasons for taking up SSM, they did not

typically use scientific tools and procedures to *monitor* outcomes systematically and validate these hypotheses in their own fields. For example a number of the farmers commented on the expected benefits soil conservation would have on the biological activity in their soils, but few sought to verify this through soil testing or systematic earthworm counts. Similarly a number of farmers argued that soil conservation would increase soil organic matter, which would in turn result in higher nutrient density in their crops; however, they did not seek to validate this through, for example, systematic tissue analysis. Instead, they referred to general scientific principles to justify their activities. As one farmer explained:

> (M15): I'm no scientist but the bits I've read other people seem to suggest that having organic matter can help with that, and if the soil biology is working better it's more able to access some of that mineral nutrition rather than just the soluble nutrition. I can't quantify any of that though. I'm a farmer not a scientist.

Furthermore, some of the farmers suggested that scientific verification of SSM would be impractical or impossible due to the difficulty of creating clear cause-effect relationships in the context of the farm as an open and complex system. What was important to them, however, was what they perceived as an overall support for SSM farming in the scientific community:

> (E4): Yeah and you are dealing with a dynamic biological system, so you don't know all the answers but it is like a gut feeling backed up by research to say if this improves the soil it will make me a more sustainable business.

Scientific narratives were especially important for farmers in justifying their practices as many of the expected effects of conservation agriculture either take a long time to become

apparent (e.g. increases in soil organic matter), or are impossible or impractical for farmers to validate in the context of individual farms (e.g. positive impacts on watershed hydrology or carbon capture). Thus, in the absence of 'tangible' outcomes the farmers could point to, scientific studies about the positive impacts of conservation agriculture on soil processes were seen as important in adding authority when explaining their unusual land management practices to others.

Contributing: developing the community of practice, and science as legitimation

Communities of practice are characterised by a constant negotiation of meaning as members seek to collectively understand and ascribe value to their experiences (Wenger, 1998). This meaning-making activity has two important aspects. Firstly, it contributes to the internal development of the CoP, enabling ongoing learning. Secondly, it allows the CoP and its members to position themselves in relation to other communities. For the farmers I interviewed, both aspects were important, and in both areas the farmers saw a role for scientific knowledge, actors and tools. The farmers argued that the learning they were already achieving from individual experimentation on farms could be strengthened through greater involvement from scientific actors and institutions. The farmers suggested that the involvement of these actors would help speed up their learning, as scientists/researchers command superior resources, and can design experiments that can better clarify cause-effect relationships. The scientists/researchers would thus be able to able to help farmers clarify the usefulness of new technologies and techniques in achieving the objectives identified by the farmers. As one farmer explained:

(E15): All I can do is experiment and see, try and find out what works. But it will take a lot longer than if I knew more specifically what… which way to go, what to try. I mean I can get hold of [new technologies] and give it a little try out, but if it won't work then I won't really know why it didn't.

The farmers interviewed also expressed a desire to demonstrate the value and validity of SSM to other land managers and to society more broadly, stressing the importance of scientific knowledge-forms in these activities. These farmers advocated for SSM through social media, organising farm visits and field walks, speaking at farming events, and participating in farmer groups. On their own farms, they were satisfied with using qualitative indicators to monitor the impacts conservation agriculture was having on their soils and businesses, noting for example changing soil structure, perceived increase in earthworm numbers, and improved animal and machinery carrying capacity. However, they believed a different approach was needed to convince other farmers:

(M15): [the proof of the positive changes I've seen] it's quite physical and quite observational rather than lab, you know, putting numbers on it, and again I know that for some people that's a problem, I've had even the farmers, when they visited you, tell them how much better it's [the soil] got and they're like yeah but you can't prove any of that and they're dead right, I can't.

The farmer quoted above was concerned that the qualitative evidence in favour of SSM would not be sufficient to convince others of its validity. For this, he suggested, it would be necessary to 'put numbers on it' and use a 'lab', thus converting anectodal evidence into 'proof'. In statements like this, the farmers called upon science to legitimise their local experiential claims; as trusted witnesses (Shapin, 1994), scientists would act as a guarantors

of the truth of their claims, strengthening the legitimacy of the individual farmer and of the CoP as a whole. Crucially, scientific knowledge was seen as having a supporting function, with its role being to legitimise the experiential knowledge of the farmers through scientifically designed trials:

> (M3): If you can put some science behind that, to back it up, and say look just after three years of doing zero till we have done this this and this to the field, as well as then being able to say, from a practical farming point of view the yields have gone up, the fertiliser use has gone down, etc., then actually you've got the scientific evidence and you've got the farmer sort of experience, that's a really good combination if you're trying to get other people to change the way they do thing.'

In this perspective scientific evidence plays a legitimising rather than a validating role; its task is not to test whether the practice is working or not but to authoritatively support the farmers' claims. This farmer (M3) is arguing that from the point of view of his needs, the SSM methods he adopted are working. The scientific method can strengthen the authority of his positive assessment, he suggests, by identifying quantitative changes soil quality. These are changes he believes have occurred, but which he has no means to fully quantify. Indeed, the farmers interviewed frequently regretted that they had not established baseline measurements before changing their soil management practices, which would facilitate generating quantifiable data.

What is important here is that these farmers placed their own values and mission at the centre, and saw themselves as well placed to generate the research questions and identify areas for work to be performed by the scientific community, as further explained by this farmer:

(S2): It's very important that the scientific community are chipping away (…) backing up all these what are effectively anecdotal reports – that's the important thing the scientific community and academic community are doing; is looking at all our weird farmer anecdotes and then methodically and studiously showing why those anecdotes are the case.

These farmers' suggestions that scientific expertise is needed to support rather than direct their SSM practice presents an important contrast to the perspective dominant both in soil science (e.g. Bouma, 2015) and knowledge extension (e.g. Lobry de Bruyn & Andrews, 2016) literature, which presents the research community as leading the soil conservation effort. Instead, from the perspective of these farmers, the leadership is coming from the farming community. The role for the scientific actors is to work with the farmers' SSM community, and help them grow the community of practice by both enhancing their learning and supporting their authority. Working together, they suggest, with the farmers identifying research needs, would both generate valuable learning by validating the hypothesis the farmers have, and create scientifically valid evidence in support of SSM methods.

Discussion

Soil scientists and researchers are increasingly concerned about influencing the farming community to enhance the uptake of SSM practices (Bouma, 2015). Encouraging greater interaction between farmers and 'experts' is also a central concern for agricultural extension scholars and practitioners (Lobry de Bruyn et al., 2017). In this paper, I argue that we should

consider not only what such interactions achieve in terms of transmission and generation of knowledge – shaping perceptions of what can be done – but also in terms of generating meaning – shaping perceptions of what is worthwhile doing. Examining SSM in England as an emerging CoP, I identify seeking, experimenting, and contributing as key stages of farmer participation. Furthermore, I draw attention to how scientific narratives, knowledge, and actors are used to inspire, justify, and legitimise SSM both as a set of practices (what can be done) and a set of meanings (what is worth doing).

Focusing on SSM as a CoP involved in a negotiation of meaning as much as in the development of new techniques shifts our understanding of farmer-scientist relations in important ways. Firstly, it changes our understanding of the role scientists and researchers who participate in knowledge exchange, science communication, or similar activities may play in influencing the uptake of sustainable or innovative farming practices. On the level of an individual farmer, taking up these practices becomes not a question of being convinced by scientific or technical information, but rather a process of entering into a community in which sustainable soil management is a valued undertaking. At the community level, scientific forms of knowledge are no longer seen as simply decision-support tools, but as narratives, which are used to build cohesion internally and to build authoritative claims for the validity and value of soil conservation externally.

Secondly, seeing SSM not only as a technical transition but also as a process of creating new meanings about agriculture suggests that the future cultures of SSM – what will emerge as the legitimate ways of doing SSM and of being a SSM farmer – are open to influence from the scientific and research communities. It is important that scientists and researchers be aware that when they communicate information and knowledge about SSM,

they also communicate potential visions of the future. It is therefore important that scientific actors become part of the discussion about the agrarian and societal values of soil conservation as much as about the technical facts of soil conservation to avoid future value conflicts (as noted in the study by Eshuis & Stuiver, 2005 in the Netherlands).

Thirdly, exploring the meaning-making aspect of conservation agriculture is an invitation to the scientific and research communities to become involved in ways that the farmers already identify as helpful and significant. The conservation agriculture CoP in England is still vulnerable to external pressures, and desires to associate itself with scientific institutions and actors as sources of authority. Furthermore, scientific inquiry can support the internal processes of learning within the CoP through the co-production of tools, narratives, case studies, or models which make it possible for others in the CoP to engage with localised learning (what Wenger, 1998 refers to as reifications). This would be seen as highly valuable by the individual farmers and by the CoP as a whole.

Conclusions

This article argues that scientists and scientific research are important to farmer uptake of sustainable soil management practices, albeit not necessarily in the ways we typically expect. There is a great appetite in the SSM community for interacting with scientists but to be effective this collaboration should be structured in ways that the farmers see as useful and relevant. To ensure lasting commitment to soil health, the research and SSM communities should work together through both the co-production of knowledge, and through the co-creation of meaning, resulting in a technically robust and societally desirable agrarian future, which puts soils at its heart.

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